



**US Army Corps
of Engineers®**



Limited Visual Dam Safety Inspections

OA00129

Waimanalo 60 MG Reservoir

Oahu, Hawaii

Prepared by:

**U.S. ARMY CORPS OF ENGINEERS
HONOLULU DISTRICT**

**STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES**

May 2006

Limited Visual Dam Safety Inspection Conducted on: 4 April 2006.

I. Purpose:

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

II. Authority

Inspections were authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statutes, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections were conducted under joint agreements of the U.S. Army Corps of Engineers (ACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

III. Scope

Visual inspection was performed on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works included the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may or may not have appeared to be any immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

IV. Limitations of Findings and Recommendations

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

Dam ID: OA-129

Name: Waimanalo 60 MG Reservoir

V. Inspection Team

Organization

State of Hawaii, Dept. of Agriculture
National Resource Conservation Service
U.S. Army Corps of Engineers

Name

Glen Okimoto
Doug Toews
Ray Kong

VI. Owner's Representatives Present

Mr. Glen Okimoto, State of Hawaii, Department of Agriculture

VII. Summary Report Team

Organization

U.S. Army Corps of Engineers

State of Hawaii, Dept. of Land and Natural Resources

Name

Mr. Derek Chow
Mr. Joseph Koester
Ms. Denise Manuel
Mr. Edwin Matsuda

VIII. Dam Type

The dam is an earthen embankment.

IX. Dam Classification

The current hazard classification of this dam is: Significant

Based on available data, this classification is believed to still be applicable.

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to occasional structures or agriculture)
Significant	Few (No Urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than a few	Extensive community, industry or agriculture.

Based on inventoried storage and height data, the size classification of the dam is: Small

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

X. Summary of Inspection:

Condition Rating Criteria: The conditional terms in this report are used to generally described the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory	Expected to fulfill intended function.
Fair	Expected to fulfill intended function, but maintenance is recommended.
Poor	May not fulfill intended function; maintenance or repairs are necessary.
Unsatisfactory	Is not expected to fulfill intended function; repair, replacement, or modification is necessary.
Unknown	Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

A. General appearance:

Most of the reservoir and dam features were easily recognizable except heavy vegetative growth on portions of the downstream slope made it impossible to conduct a detail inspection of it.

Modifications / Improvements: The downstream slope was repaired after it partially failed according to Doug Towes, NRCS. Also, the downstream channel was repaired and lined with riprap for protection after it was deeply scoured during a past sizable storm event. According to staff personnel, the only rainfall that contributes to the inflows is from the surface area of the reservoir.

Findings and Corrective Actions:

- a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- b. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- c. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- d. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- e. Routine inspection logs were not inspected.
- f. Dam owners shall provide for routine inspection of the dam.
- g. Access to site appears to be satisfactory.
- h. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.

- i. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- j. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- k. Emergency Alarms. There were no alarms observed on this reservoir.
- l. Power / Communication. There were no communication systems observed on this reservoir.

B. Access / Security:

Access to the dam was accomplished via a County roadway.

A four wheel drive vehicle is not required except during severe storm conditions.

Security issues. Access to the dam is via a locked gate.

C. Inflow Works:

The inflow works were not observed. However according to staff personnel, there is one inlet feeding the reservoir. This is a 16-inch pipe.

The intake or inlets have the ability to be shut off or diverted away from the reservoir during periods of heavy rains. This is done manually.

Findings and Corrective Actions:

- a. The inflow works were not inspected.
- b. The inflow works were not tested.
- c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.

D. Reservoir

The reservoir level during the inspection was 61.5 feet per staff gage.

According to staff personnel, the reservoir is normally operated at the range observed during the inspection.

Findings and Corrective Actions:

- a. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.

E. Upstream Slope (Satisfactory)

The upstream slope stands at a 1V:2H (Vertical / Horizontal).

The slope and reservoir is lined with 60 mil HDPE liner. The existing surface is not visible. Erosions were not observed, the slope was not entirely visible.

Cracks were not observed, the slope was not entirely visible.

Sinkholes were not observed, the slope was not entirely visible.

A major portion of the upstream slope was covered with water and not visible.

Findings and Corrective Actions:

- a. The upstream slope was not fully inspected.
- b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.

F. Crest: (Satisfactory)

The dam crest was approximately 16 feet wide

There was a gravel surfaced access road on top of the crest with grass growing through it.

Findings and Corrective Actions:

- a. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- b. Access along the crest was satisfactory.

G. Downstream Slope: (Fair)

A major portion of the downstream slope was not visible due to heavy vegetation.

There was an overgrown access roadway along the downstream toe.

There was no slope protection observed on the downstream slope.

Erosion was not observed on the downstream slope, however the slope was not entirely visible.

Sinkholes were not observed on the downstream slope, however the slope was not entirely visible.

Vegetation was observed on the downstream slope. The majority of the vegetation was bushes with tall grass and woody trees.

Seepage was not observed on the downstream toe, however the slope was not entirely visible.

Findings and Corrective Actions:

- a. The downstream slope was not fully inspected.
- b. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- c. Clear high vegetation and maintain low to enable easy visual inspection.
- d. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

H. Abutments / Toe: (Fair)

The abutments and toe were not entirely visible or identifiable due to heavy vegetative growth.

Cracks in either direction were not observed, however the toe was not entirely visible.

There was heavy vegetation along the toe locations.

Findings and Corrective Actions:

- a. The toe was not fully inspected.
- b. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
- c. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- d. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

I. Outlet Works: (Satisfactory)

Not inspected in detail, not tested.

The outlet works was controlled via a gate valve on the downstream side of the dam.

Findings and Corrective Actions:

- a. The outlet works were not inspected.
- b. The outlet works were not tested.
- c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.

J. Spillway: (Fair)

This spillway consisted of an HDPE lined channel transitioning to a grass lined swale then a riprap lined channel.

The spillway approach was clear.

Further investigations should be conducted to conclude the capacity of the spillway.

Findings and Corrective Actions:

- a. The Spillway appeared to be in fair to poor condition and requires corrective action.
- b. The spillway downstream was partially blocked by vegetation. Clear approach.
- c. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.

K. Down Stream Channel: (Fair)

The down stream channel was not fully investigated.

There appears to be a well defined downstream channel.

Findings and Corrective Actions:

- a. The downstream channel was not fully inspected.
- b. The downstream channel appeared to be in fair to poor condition and requires corrective action.
- c. Clear trees within the channel.

XI. Additional Comments:

Original field inspection notes were scanned and are attached to this summary report. Included are several photos from the site visit to detail important features of the project, captioned to be self-explanatory.

Per e-mail dated 5/17/2006, 8:51a.m. from Ray Kong

Reservoir: Please indicate the normal operating level.

Normal operating level was the same as the level we observed, around 62'.

Was there a staff gage, if yes, where? Yes, makai side of the spillway.

Intake Works: Can you recall what kind of pipe?

Didn't see any, just read the as-built plans.

Please provide information on the control: gate or valve, and if the flow can be shut off

Valve controlled

Please provide information where the source of water is from

Didn't ask, assume from the adjacent Koolau Mountain.

Outlet works: Please provide information on the control type: gate or valve Valve

Also, is the pipe DIP? Yes

Please indicate if seepage was observed? None was observed.

Spillway: Please provide the dimension of the spillway. About 20' wide by 40' long.

Downstream Channel: Please indicate if the channel was a defined drainage-way.

Yes it is a defined drainage-way.

Please indicate if items along the stream bank were inspected, and if any items were seen.

Trees and bushes along the drainageway for the distance we observed, about 500'.

Comments: Did the reservoir present a safety hazard at the time of inspection?

No immediate threat to the dam structure was observed on the day of our inspection.

Recommend all trees be removed from the downstream slope of the embankment so a more thorough inspection can be performed.

PHOTOGRAPHS

Dam ID: OA-129

Name: Waimanalo 60 MG Reservoir



View of lined reservoir



View of reservoir

Dam ID: OA-129

Name: Waimanalo 60 MG Reservoir



View of reservoir and
lined upstream slope



View of the well manicured
downstream slope

Dam ID: OA-129

Name: Waimanalo 60 MG Reservoir



Heavily vegetated
downstream slope



Abutment area

Dam ID: OA-129

Name: Waimanalo 60 MG Reservoir



Downstream channel, improved with riprap after an incident that eroded the channel

View of spillway from the crest

Dam ID: OA-129

Name: Waimanalo 60 MG Reservoir



View of spillway looking downstream, notice vegetation



View of the outlet works

FIELD INSPECTION SHEETS

Dam ID: OA-0129
WAIMANALO 60 MGD RESERVOIR

Vulnerability Index:
Extreme High Moderate Low
1 2 3 4

Inspection No: _____
Date: 4 April 2004

STATE OF HAWAII - DLNR
DAM SAFETY INSPECTION SHEET

Inspection Type: Visual Dam Safety Inspection

Persons Present	Affiliation	Phone Number
<u>RAY KONG</u>	<u>US Army Corps of Engineers</u>	
<u>DONG TOWNS</u>	<u>NRCS</u>	
<u>GLEN OKIMOTO</u>	<u>DOK, State</u>	

Weather Condition: ☐ Rain previous day ☐ Rainy ☐ Drizzle / Mist ☐ Cloudy/Overcast ☒ Partly Cloudy ☐ Sunny ☐ Dry
Comments: _____

1. General: (Information currently on file, update as required)

Dam/Res. Name	<u>WAIMANALO 60 MGD RESERVOIR</u>		
Owner	<u>State of Hawaii, Department of Agriculture</u> (C027)		
Owner Contact	<u>Mr. Brian Kau</u>	Owner Ph.	_____
Lessee	_____	Lessee Ph.	_____
O & M Contractor	<u>Waimanalo Irrigation System</u>	O & M Ph.	_____
Nearest Town	<u>WAIMANALO</u>	Latitude	<u>21.3433° (decimal)</u>
County	<u>HONOLULU</u>	Longitude	<u>157.7367° (decimal)</u>
Tax Map Key(s)	<u>(1)4-1-010:002</u>		

Dam Status	<u>A:</u>	Hazard Potential	<u>S HIGH</u>	Dam Size	_____
Year Completed	<u>1993</u>	Dam Length	<u>2118</u> ft.	Dam Height	<u>62</u> ft.
Normal Storage	<u>182</u> ac.ft.	Max. Storage	<u>182</u> ac.ft.	Max. Surface Area	<u>5</u> ac.
Drainage Area	_____ mi.	Spillway Type	_____	Max. Spillway Q	<u>200</u> cfs

Owner owns land under dam facility: _____
Emergency Action Plan on file with the Department: NO
Reports on file with the Department: None on file.

Dam ID: OA-0129
WAIMANALO 60 MGD RESERVOIR

Inspection No: _____

Date: 04/04/06

2. Questions for Owner's Rep.:

	Yes	No	Unknown	Comments
Construction Plans Available	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Asbuilt, July 15, 1993</u>
Site / Facility Map	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Operation & Maintenance Manual	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<u>Have O & M Agreement (DOA & NRCS)</u>
Emergency Action Plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Modifications / Improvements	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Rock buttress D/S toe (1994), Armour spillway (2001)</u>
Conduct Routine Inspections	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Conduct Routine Maintenance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Vehicle access to site	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input checked="" type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Access during heavy rains	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input checked="" type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Access when spillway is flowing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Not accessible <input checked="" type="checkbox"/> With Standard car <input type="checkbox"/> Requires 4-Wheel Drive
Other Studies Conducted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Phase I <input type="checkbox"/> Phase II <input type="checkbox"/> Hydraulics <input type="checkbox"/> Stability <input type="checkbox"/> Hazard <input type="checkbox"/> Seismic <input type="checkbox"/> Other: _____
Incident History	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Breached <input type="checkbox"/> Overtop <input checked="" type="checkbox"/> Slide <input type="checkbox"/> Down stream Flooding <input checked="" type="checkbox"/> Other: <u>REPAIRED AFTER 1-YR IN SERVICE</u>
Reservoir's Current Use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Sediment <input checked="" type="checkbox"/> Irrigation <input type="checkbox"/> Recreation <input type="checkbox"/> Flood Control <input type="checkbox"/> Drinking Water <input type="checkbox"/> Power Generation <input type="checkbox"/> Other: _____

Findings and Corrective Actions:

- ☒ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility. 4/23/06
- ☐ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☒ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility. 4/23/06
- ☐ d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☐ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☒ f. Routine inspection logs were not inspected.
- ☒ g. Dam owners shall provide for routine inspection of the dam. 4/23/06
- ☐ h. The dam did not appear to be maintained on a regular basis.
- ☐ i. Access to site appears to be satisfactory.
- ☐ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☐ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☐ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☒ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility. 4/23/06
- ☒ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits. 4/23/06
- ☐ o. _____

Additional Requirements:

The following investigative study(s) are:

Required Recommended

- | | | |
|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | Phase I Study |
| <input type="checkbox"/> | <input type="checkbox"/> | Phase II Study (Including <input type="checkbox"/> Seepage <input type="checkbox"/> Hydrology/Hydraulics <input type="checkbox"/> EAP) |
| <input type="checkbox"/> | <input type="checkbox"/> | Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity) |
| <input type="checkbox"/> | <input type="checkbox"/> | Stability Analysis |
| <input type="checkbox"/> | <input type="checkbox"/> | Seismic Analysis |
| <input type="checkbox"/> | <input type="checkbox"/> | Hazard Classification |
| <input type="checkbox"/> | <input type="checkbox"/> | Other: _____ |

Dam ID: OA-0129
WAIMANALO 60 MGD RESERVOIR

Inspection No: _____
Date: 04/04/06

Physical Dam Features: (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

3. Reservoir: HDPE LINED (60 mil) 62 61.5'
Level during inspection 30 ft per staff (gage / other) to spillway elev.
Normal Operating Level/Range _____ ft per _____ (gage / other)
Description: _____
Typical Operation ☐ Spillway always flowing ☒ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☐ Only filled by Storms
☐ Other: _____
Sinkhole in Res.: ☐ # Observed: _____ Size: _____ by _____ in. Deep ☐ Not Visible ☒ None Observed
Description: _____
Staff Gage: Description: _____

Findings:

- ☐ a. The reservoir was not inspected.
☒ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The reservoir appeared to be in fair to poor condition and requires corrective action.
☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

- ☐ e. The staff gage needs maintenance and/or repair. Description: _____
☐ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
☐ h. _____

4. Intake Works Description:

☒ Number of Intakes 1
☒ Intake Culvert / Pipe
Size: 24" 16 in. ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____
Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed
From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____
☐ Ditch / Flume
Dimension: _____ (Size x Depth) Shape _____
Surface: ☐ Dirt ☐ Wood ☐ Concrete ☐ Lined w/ _____
Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed
From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

Findings:

- ☒ a. The intake works were not inspected.
☐ b. The intake works were not tested.
☐ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

- ☐ f. The intake works needs maintenance and/or repair. Description: _____
☐ g. _____

Dam ID: OA-0129
WAIMANALO 60 MGD RESERVOIR

Inspection No: _____
Date: 04/04/06

5. Upstream Slope:

(Typical Slope \pm 2¹/₄ : 1) ✓

Slope Protection: ☐ None ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☒ Liner HORE ☐ Other: _____
☐ Defect in Protection: Description: _____
Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed
Description: _____
Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed
Description: _____
Sinkholes: ☐ # Observed: _____ Size: _____ and _____ Depth ☐ Not Visible ☒ None Observed
Description: _____
Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: _____

Findings:

- ☐ a. The upstream slope was not inspected.
- ☒ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The upstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair.
Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ k. _____

6. Crest:

Approximate Crest Width: 16'

Access: ☐ None ☐ Walking Path ☒ Roadway, Surface / Width / Usage: _____

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☒ None Observed

Description: _____

Vegetation: ☐ None ☒ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Findings:

- ☐ a. The dam crest was not inspected.
- ☒ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Access along the crest was satisfactory.
- ☐ f. Access along the crest was not possible. Description: _____
- ☐ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair.
Description: _____
- ☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ l. _____

7. Downstream Slope:

(Typical Slope ± 2H : 1V)

Access: ☒ lower roadway along toe ☐ roadway to outlet works ☐ walkway to outlet works ☐ None Observed

Slope Protection: ☒ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap ☐ Concrete

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☒ None Observed

Description: _____

Vegetation: ☐ None ☒ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Seepage: Seep Spot Number 1

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Seep Spot Number 2

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

- ☐ a. The downstream slope was not inspected.
- ☐ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair.
Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☒ g. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ h. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☐ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.
- ☐ k. _____

8. Abutments/Toe:

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed
Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: _____

Seepage: Seep Spot Number 1
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed
☐ Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Seep Spot Number 2
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed
☐ Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Findings:

- ☐ a. The abutments/toe were not inspected.
- ☒ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair.
Description: _____
- ☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☒ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☐ l. _____

Dam ID: OA-0129

WAIMANALO 60 MGD RESERVOIR

Inspection No: _____

Date: 04/04/06

9. Outlet Works:

Culvert / Pipe

Type / Size:

24"

12" DRAIN PIPE

Culvert:

☐ Concrete

☐ Masonry

☐ unlined earth

☐ Other

Pipe:

☐ DIP

☐ Corrugated Metal

☐ PVC

☐ HDPE

☐ Concrete

☐ Other

Control Type:

☐ Gate

☐ Valve

☐ Other

Location:

☐ Control on Upstream side

☐ Control on Downstream side

Seepage:

☐ Green Vegetation

☐ Wet or Muddy Ground

☐ Ponding Water

☐ Not Visible

☐ None Observed

☐ Flowing, Description:

Water Clarity:

☐ Clear

☐ Some particles

☐ Muddy

☐ Other:

Description:

Findings:

- ☐ a. The outlet works were not inspected.
- ☐ b. The outlet works were not tested.
- ☒ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ d. The outlet works appeared to be in fair to poor condition and requires corrective action.
- ☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
- ☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.
- ☐ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ i. _____
- ☐ j. _____

Dam ID: OA-0129

WAIMANALO 60 MGD RESERVOIR

Inspection No: _____

Date: 04/04/06

10. Spillway:

Type: ☐ None ☐ Culvert/Pipe ☒ Channel

Description: _____

Dimension: _____ ft. Invert elevation: _____ ft. per staff gage

Slope Protection: ☐ None ☒ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☒ Concrete

☐ Defect in Protection: Description: _____

Approach: ☒ Clear ☐ High Veg. ☐ Trees ☐ Other: _____

Erosion: ☐ Scour ☐ Gully ☐ Headcut ☒ Not Observed ☐ Other: _____

Description: _____

Vegetation: ☐ None ☒ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees # _____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: CLEAN VEGETATION ON FENCE AND BEHIND

Findings:

- ☒ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ b. The Spillway appeared to be in fair to poor condition and requires corrective action.
- ☐ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ d. Slope protection needs maintenance or repair. Description: _____
- ☒ e. The spillway approach was blocked. Clear approach downstream.
- ☐ f. Severe scour erosion was observed which requires maintenance and/or repair. Description: _____
- ☐ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.
- ☐ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.
- ☐ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.
- ☐ j. _____

11. Down Stream Channel:

Name: _____

Downstream: ☐ Sump ☐ Open Area ☐ Un-Defined Drainage-way ☐ Defined Drainage-way ☐ Other _____

Items along Stream Bank: ☐ None ☐ Road ☐ Houses ☐ Town ☐ Not Inspected

Description: NEAR SPILLWAY FLOWED ~ 2000 RISED PER DOUG

Findings:

- ☒ a. The downstream channel was not inspected.
- ☒ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☒ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Remove woody vegetation from rock-lined spillway channel.

Dam ID: OA-0129
WAIMANALO 60 MGD RESERVOIR

Inspection No: _____
Date: 04/04/06

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.